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THE INFLUENCE OF CHEMICAL AGENTS ON MECHANICAL DEHYDRATION OF BY-PRODUCTS FROM SUGAR BEET PROCESSING INDUSTRY

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A b s t r a c t. When treating sugar beet by modern mechanical procedures, from the phase of picking up to processing, the considerable amounts of plant refuses are left. The refuses such as sugar beet leaves, fragments, tails and grass, if processed or preserved adequately, can be used as animal feed. The additional economic and ecological problems are created if this refuses are used inadequately. The possible utilization of Ca-ions from $CaSO_4$ in pressing waste biomass from sugar rafineries was investigated in this work. The aim was to obtain the pressed pulp with increased content of dry matter and press juice with satisfactory feeding value. The efficiency of pressing of the organic refuses from sugar industry can be improved by the use of $CaSO_4$ as additional chemical agent and with heating the disintegrated mass. When using 680 g $CaSO_4$/t of biomass and by heating up to 60 ^oC, the yield is 35 t of pressed pulp containing 31 % dry matter and 65 t of press clear juice with 11 % dry matter from 100 t of processed biomass.

K e y w o r d s: sugar beet by-products, chemical agents, mechanical dehydration, pressing

INTRODUCTION

When treating sugar beet by modern mechanical procedures, from the phase of picking up to processing, the considerable amounts of plant refuse are left. The refuses such as sugar beet leaves, fragments, tails and grass, if processed or preserved adequately, can be used as animal feed. The additional economic and ecological problems are created if these refuses are used inadequately.

It has been known for a long time that plant refuses with high nutritive value can be used as fresh, ensiled or dry animal feedstuffs [13] particulary in swine nutrition [5]. It has been found that dry feedstuff from these by-products has nutritive value similar to the value of barley grain in swine nutrition [11] and press juice has somewhat better nutritive value than corn grain [12]. The factor limiting the use of these feedstuffs is the increased content of oxalic acid, specially in sugar beet leaves and tops. The negative Ca-balance, hypocalcemie and alcalosis can be induced in animal organism [4] due to the increased content of oxalic acid. However, this adverse effect can be overcome to a rather great extent by including higher concentrations of Ca in animal diets.

The other limiting factor is the high rate of water in this material (80-85 %) influencing its keeping and microbiogical stability. Therefore, nearly all the procedures of valorization of these by-products include the phases of mechanical and thermal removal of water that is, pressing and drying.

The energy consumption for thermal water removal compared to mechanical removal is four times higher and because of that the procedures of pressing the plant material from sugar industry received an increased attention over the past twenty years. Besides the improving of the press design characteristics and finding the optimum technological parameters for the corresponding quality of the material to be pressed, the additional chemical agents are often used to change the cellulose-pectin complex in plant material and to remove water more efficiently.

The possible utilization of Ca^{2+}- ions from $CaSO_4$ in pressing waste biomass from sugar rafineries was investigated in this work. The aim was to obtain the pressed pulp with increased content of dry matter and pressed juice with satisfactory feeding value.

The use of additives in pressing plant materials

The first attempts to improve the pressing of materials from sugar industry were made in early fifties [1]. The $Ca^{2+}$and Al^{3+} cations were used in pressing alkalized beet pulp. The improvement was small but the experimental results have encouraged the investigators to study further the essence of the pressing process. Now, calcium chloride [8,13], aluminium sulphate [10] and calcium sulphate are the most often used [9]. These additional chemical agents acidify the medium fixing H-ions into pectin structure and they also introduce di- or threevalent cations into pectin chain improving considerably the permeability of the layer of the material pressed.

When this biomass is intendend to be used as animal feed, the used Al^{3+} is limited or even excluded and Ca^{2+} is used instead of it [7]. In this way the adverse effects of oxalic acid is neutralized in these by-products.

MATERIALS AND METHODS

The processing of by-products from sugar industry into animal feedstuffs involves several phases: collecting of organic refuses, washing and removing of admixes, grinding to uniform particles, pressing of disintegrated mass and drying of pulp pressed [2,6].

As regards the energy consumption in this process, it is most important to obtain the pressed pulp with the highest dry matter (DM) content as possible. Therefore, various amounts of $CaSO_4$ were added into the mass prior to disintegrator and after that mixed well. The mass was heated further to about 60 °C and pressed.

The biomass taken directly from sugar rafinery was used in our investigation.

RESULTS AND DISCUSSION

The chemical composition of the by-products collected is shown in Table 1. The basic characteristics of the press juice and pulp pressed with addition of chemical agents and with heating or without additives and without heating of disintegrated mass are shown in Table 2.

As it can be seen in Table 2, the use of $CaSO_4$ significantly improved the pressing efficiency of the organic biomass from sugar industry. At the temperature of 20 °C and at the concetration of 680 g of $CaSO_4$ per one tone of mass, the efficiency of pressing was improved by 11.7 % (that is, by 3 points). Under the same operating conditions but at the temperature of 60 °C, the pressing efficiency was improved by 22.3 % (that is 5.7 points). The increase of dry matter content in pulp pressed was somewhat higher when the level of 1 020 g $CaSO_4$/t mass was used but is more economic to 680 g/t of mass with heating up to 60 °C.

Table 1. Basic characteristics of waste biomass

DM, %	18.60
Protein, % in dry matter	9.28
Fibre, % in dry matter	15.61
Fat, % in dry matter	1.32
Mineral matters, % in dry matter	12.43
Total sugars, % in dry matter	33.90

As regards the temperature effect on the pressing efficiency under some other conditions, the increase of the temperature from 20 °C to 60 °C improved pressing by 3.9 % (with no additives) that is, by only 9.4 % with the use of 680 g $CaSO_4$/t of mass. When expressed in the form of the differences of dry matter contents in the individual

Table 2. The characteristics of pulp pressed and press juice

No. of samples	$CaSO_4$ concentr. (g/t mass)	Temp. (^oC)	Juice		Pulp pressed	
			Amount (%)	DM (%)	Amount (%)	DM (%)
1	0	20.0	52.3	10.8	47.7	25.6
2	340	20.0	53.4	11.0	46.6	26.4
3	680	20.0	60.3	11.1	39.7	28.6
4	1020	20.0	61.3	11.1	38.5	29.4
5	0	60.0	51.6	10.3	48.4	26.6
6	340	60.0	54.3	10.8	45.7	27.0
7	680	60.0	65.4	11.2	34.8	31.3
8	1020	60.0	66.8	11.2	33.2	32.3

samples, this increase was 1.1 point in the former case, that is 2.7 points in the latter one.

CONCLUSION

The efficiency of pressing of the organic refuses from sugar industry can be improved by the use of $CaSO_4$ as additional chemical agent and with heating the disintegrated mass. When using 680 g $CaSO_4$/t of biomass and by heating up to 60 °C, the yield is 35 t of pressed pulp containing 31 % dry matter and 65 t of press clear juice with 11 % dry matter from 100 t of pressed biomass.

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